$$y(t) = A\cos(\omega t + \phi)$$

$$y(x) = A\cos(kx + \phi)$$

$$v = \frac{\omega}{k}$$

$$y(x,t) = A\cos(kx - \omega t + \phi)$$

$$v_y(x,t) = \frac{\partial y(x,t)}{\partial t}$$

$$v_y(x,t) = \omega A\sin(kx - \omega t + \phi)$$

$$a_y(x,t) = \frac{\partial v_y(x,t)}{\partial t}$$

$$a_y(x,t) = -\omega^2 A\cos(kx - \omega t + \phi)$$

$$\text{KE} = \frac{1}{2}M{v_y}^2$$

$$\text{KE} = \frac{1}{2}M\left(-\omega A\sin(kx - \omega t + \phi)\right)^2$$

$$\text{KE}_{\text{avg}} = \frac{1}{2}M\left(\omega^2 A^2\ \frac{1}{2}\right)$$

$$\begin{aligned}\text{total E} &= \text{KE}_{\text{avg}} + \text{PE}_{\text{avg}} \\ &= \frac{1}{2}M\left(\omega^2 A^2\ \frac{1}{2}\right) + \frac{1}{2}M\left(\omega^2 A^2\ \frac{1}{2}\right)\end{aligned}$$

$$\text{total E} = \frac{1}{2}M\omega^2 A^2$$

$$\mu \equiv \frac{M}{d}$$

$$M = \mu v t$$

$$\text{total E} = \frac{1}{2}\left(\mu v t\right)\omega^2 A^2$$

$$\text{power P} = \frac{1}{2}\left(\mu v\right)\omega^2 A^2$$